THURSDAY, JANUARY 23, 1873

THE NAVY AND SCIENCE

IT would be difficult to estimate the many excellent effects that are likely to result from the establishment of the Royal Naval College, which, as has been at last authoritatively intimated, is to be opened on February 1, in those noble halls at Greenwich that for so long have been associated in another way with the British Navy. Her Majesty's Government deserve the highest praise for the wisdom—provokingly tardy though it has been—displayed in the thorough and handsome provision they have made for the scientific education of our naval officers. Much that is sarcastic, no doubt, might be said on this tardiness of a Government which seldom moves until it is driven; but as we fear this would do little good, we shall only express a hope that in future when they are compelled to take action in any matter, especially if it be scientific, they will do so as decidedly and sweepingly as they have done in the present instance.

It is usually acknowledged that the very existence of Britain as a first-rate Power depends upon the efficiency of her navy, and yet it is a lamentable fact that hitherto no nation in the world of any consequence has made less systematic provision for the training of the members of her navy than has our own. Our naval officers and seamen have been left pretty much to haphazard to gain a knowledge of their profession, and, indeed, until recently it would have been generally thought derogatory to what is vaguely known as "British pluck," had it been hinted that it would be not less plucky were it well informed; that it would have a better chance to beat all the forces in the universe, did it know the scientific principles on which a few of these forces rested. Happily this is no longer the case; the strong light of science, "the irresistible logic of facts," has shown this old knowledge to be but ignorance; and let us rejoice that this great light has at last dawned upon the magnates of our navy, and dispersed the great darkness in which they have for so long sat. The college to be opened on Feb. 1, if we may judge from the prospectus, will furnish as thorough a scientific education in the branches to be taught as can be obtained at any similar institution in any country in the world.

The immense advantages that are likely to accrue to the British Navy as such, from the excellent training which its officers must undergo at the new Naval College, are evident to all, and have been already pointed out in the columns of the general press. For one thing it will reduce the incompetents and idlers to a minimum. We are inclined to think that the gains to Science from the establishment of such an institution will be of not less importance than the increase in the efficiency of the navy which must be its special result. Our naval officers form a large, important, and influential body, having opportunities for scientific research all over the world which all students of nature must envy. Even under the old *régime* many of the most important additions to scientific knowledge in various departments were made by naval officers, some of whom have won for themselves deathless names as scientific explorers. What then must be the conquests of Science in the future when every naval officer who is capable of profiting by the instruction to be furnished at Greenwich will go forth trained and equipped to wrest from Nature some of the many secrets which she still holds in her grasp? What an immense advantage must it be to any scientific or exploring expedition when the officers that command the ship are as capable of unravelling the mysteries of Nature as they are of boxing the compass. But it would be impossible to enumerate all the advantages that we may reasonably expect to accrue to Science from the step taken by the Lords of the Admiralty. The scheme of education as it stands on paper is admirable, and most comprehensive as to subject and as to the classes for whose advantage it has been drawn out; with Rear-Admiral Kay as President of the College, and Dr. Hirst as Director of Studies, we have every reason to hope that the Royal Naval College will "become, not only an educational establishment affording the means of the highest training in theoretical subjects to naval officers of all classes, but also a nucleus of mathematical and mechanical science specially devoted to those branches of scientific investigation which have most interest for the navy."

We can only hope that the excellent example set by the Lords of the Admiralty will in a very short time be followed by the authorities of the War Office. Does not the profession of a military officer at the present day require as thorough a training to be able to fill it efficiently, as does that of a naval officer? Are not the very highest scientific principles being brought to bear on the elaboration of military weapons, and military tactics? and would not military officers, like naval officers, perform the duties of their profession more efficiently if they had a systematic training in the sciences from which modern tactics draw their life? But sad to say, the military authorities have recently shown a tendency to take the very opposite course to that which our more advanced naval authorities have so commendably followed. We hope the example of the latter will ere long shame the former into mending their ways.

The following are some of the principal points in the minute issued by the Lords of the Admiralty:—

"The College, subject to the subjoined Regulations, will be open to officers of the following ranks:—1. Captains and Commanders. 2. Lieutenants. 3. Navigating Officers. 4. Naval Instructors. 5. Acting Lieutenants and Acting Sub-Lieutenants. 6. Officers, Royal Marine Artillery; ditto, Royal Marine Light Infantry. 7. Officers of the Engineer Branch, viz.:—Chief Engineers, Engineers, 1st Class Assistant Engineers, Acting 2nd Class Assistant Engineers. 8. A limited number of Dockyard Apprentices will be annually selected, by competitive examination, for admission to the College. A course of instruction at the College will also be open to a limited number of:—9. Private students of Naval Architecture or Marine Engineering. 10. Officers of the Mercantile Marine.

"It is not intended to provide at Greenwich for the education of the Naval cadets. My Lords intend that the Royal Naval College at Greenwich shall be so organised as to provide for the education of naval officers of all ranks above that of midshipman, in all branches of theoretical and scientific study bearing upon their profession; but my Lords will continue the instruction given in the *Excellent* gunnery-ship as heretofore, and arrangements for instruction in practical surveying will also be con-

No. 169—Vol. vii.

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tinued at Portsmouth. My Lords desire by the establishment of the College, to give to the executive officers of the navy generally every possible advantage in respect of scientific education; but no arrangements will be made at all prejudicing the all-important practical training in the active duties of their profession. The object of securing, in the interest of the naval service, the highest possible scientific instruction is, in the opinion of my Lords, most effectually to be attained by bringing together in one establishment all the necessary means for the higher education of naval officers and of others connected with the navy. . . . Complete courses of study suitable for the different classes of students admitted will be organised, and will be carried out by professors, lecturers, and instructors. Officers and others admitted as students will have the advantage of these courses of study, whether they reside or not. But officers and others who may not become students will, under certain regulations, have free access to separate courses of lectures, the benefit of which it is desired to extend as far as possible."

The following are the proposed courses of study:—

"1. Pure Mathematics, including co-ordinate and higher Pure Geometry, Differential Calculus, Finite Differences, and the Calculus of Variations. 2. Applied Mathematics, viz., Pneumatics, Mechanics, Optics, and the Theories of Sound, Light, Heat, Electricity, and Magnetism. 3. Applied Mechanics, including the Theory of Structures, the principles of Mechanism, and the Theory of Machines. 4. Nautical Astronomy, Surveying, Hydrography, with Maritime Geography, Meteorology, and Chart Drawing. 5. Experimental Sciences:—*a.* Physics, viz., Sound, Heat, Light, Electricity, and Magnetism; *b.* Chemistry; *c.* Metallurgy. 6. Marine Engineering, in all its branches. 7. Naval Architecture, in all its branches. 8. Fortification, Military Drawing, and Naval Artillery. 9. International and Maritime Law; Law of Evidence and Naval Courts Martial. 10. Naval History and Tactics, including Naval Signals and Steam Evolutions. 11. Modern Languages. 12. Drawing. 13. Hygiene—Naval and Climatic. A certain latitude in selecting such courses of study as they may prefer will be allowed to officers voluntarily attending the College. Officers and others required to attend by the Regulations will follow such courses of study as may from time to time be prescribed.

"The general organisation of the College will be as follows:—A flag officer will be president; he will be assisted by a captain in the Royal Navy in matters affecting discipline, and in the internal arrangements of the College unconnected with study. A director of studies will, under the president, organise and superintend the whole system of instruction, and the various courses of study. There will further be—A professor of mathematics, a professor of physical science, a professor of chemistry, a professor of applied mechanics, a professor of fortification. Such instructors in mathematics and the other branches specified as may be necessary to assist the professors will be added to the staff. Lecturers will be appointed to deliver courses of lectures in naval architecture, metallurgy, civil and hydraulic engineering, maritime law, naval history and tactics, and hygiene. A naval officer will conduct instruction in nautical astronomy and surveying, and there will be two instructors in steam. Such provision will be made for instruction in French and German and in drawing, as the number of students desirous of following courses in these branches may render necessary. . . .

"Arrangements have been made for the admission of naval engineer officers to the College, which will prevent time spent at the College from entailing any pecuniary loss upon them. The School of Naval Architecture at South Kensington will be absorbed in the Royal Naval College, Greenwich. The regulations for the admission of engineer students and of dockyard apprentices have been so framed as to provide as nearly as possible the same aggregate time for their instruction as that which is now afforded at South Kensington. Further regulations will be issued by their lordships in regard to the admission of private students to the course of study at the College on similar conditions to those now existing at South Kensington. My Lords have further determined to admit a limited number of officers of the Mercantile Marine as students of the College, enjoying the full advantages of the whole course of instruction and tuition by the educational staff, while officers of the Mercantile Marine generally will, on application, be allowed to attend courses of lectures.

"The paramount object which my Lords have pursued in the organisation of the College has been to provide the most efficient means for the higher education of naval officers adequate to the constantly increasing requirements of the service; but my Lords also anticipate great advantages from the results likely to accrue from the connection which will be established through the College between men distinguished in the various departments of mathematical, physical, and chemical science, and those practical problems which so vitally interest the navigator, the naval architect, and the naval engineer. My Lords expect the College to become, not only an educational establishment affording the means of the highest training in theoretical subjects to naval officers of all classes, but also a nucleus of mathematical and mechanical science specially devoted to those branches of scientific investigation which have most interest for the navy."

ELECTROSTATICS AND MAGNETISM

Reprint of Papers on Electrostatics and Magnetism. By Sir W. Thomson, D.C.L., LL.D., F.R.S., F.R.S.E., Fellow of St. Peter's College, Cambridge, and Professor of Natural Philosophy in the University of Glasgow. (London: Macmillan and Co., 1872.)

TO obtain any adequate idea of the present state of electro-magnetic science we must study these papers of Sir W. Thomson's. It is true that a great deal of admirable work has been done, chiefly by the Germans, both in analytical calculation and in experimental researches, by methods which are independent of, or at least different from, those developed in these papers, and it is the glory of true science that all legitimate methods must lead to the same final results. But if we are to count the gain to science by the number and value of the ideas developed in the course of the inquiry, which preserve the results of former thought in a form capable of being employed in future investigation, we must place Sir W. Thomson's contributions to electro-magnetic science on the very highest level.

One of the most valuable of these truly scientific, or *science-forming* ideas, is that which forms the subject of the first paper in this collection. Two scientific problems, each of the highest order of difficulty, had hitherto been considered from quite different points of view. Cavendish and Poisson had investigated the distribution of electricity on conductors on the hypothesis that the particles of electricity exert on each other forces which vary inversely as the square of the distance between them. On the other hand Fourier had investigated the laws of the steady conduction of heat on the hypothesis that the flow of heat from the hotter parts of a body to contiguous parts which are colder is proportional to the rate at which the temperature varies from point to point of the body. The physical ideas involved in these two problems are quite different. In the one we have an

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